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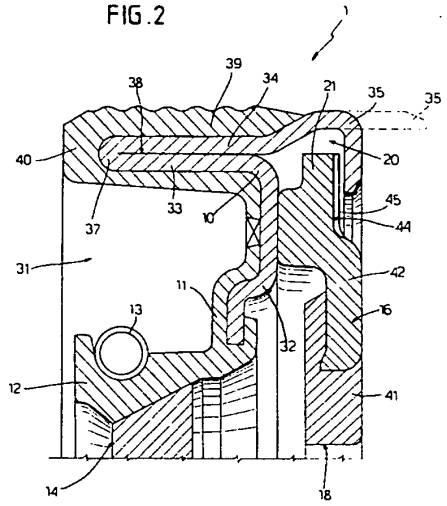
## (54) Rotary shaft seal with a protection and centering element.

(57) A seal (1) for the seat of a rotary shaft (3), including a metal support (10); an elastomeric element (11) cured on to the support and having at least one annular sealing lip (12); and a sealing lip protection and centering element consisting of a dust ring (16) interference fittable to the shaft (3) so as to rotate, in use, angularly integral with it, and housed idly inside an annular channel seat (20) formed integral with the support (10) and radially and axially outwards of the seat in relation to the sealing lip (12).

FIG.2

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The present invention relates to a seal for rotary shaft seats, fittable to rotary shafts for effecting a low-friction sliding seal, and featuring, for the sealing portion, a centering and protection element forming an integral part of the seal itself.

Rotary shaft seals generally comprise a metal support for fitment inside the shaft seat; and an elastomeric element cured on to the support and having one or more annular sealing lips designed, with a small amount of interference, to mate with and effect a sliding seal on the outer lateral surface of the shaft, for which purpose the lip may present pressure elements such as garter springs or similar.

When seating the seal and/or shaft, relative axial slide is incurred between the seal and shaft, which, particularly if they are not perfectly centered, may cause irreparable damage to the sealing lip, thus impairing the efficiency or, at any rate, reducing the working life of the seal. Moreover, any off-centering between the seal and shaft may result in severe in-service friction and localized leakage. To overcome the above drawbacks, seals are known to be fitted with protection and centering elements consisting of disposable rigid sleeves, which are fitted to the sealing lip/s and eliminated using special tools during assembly.

The above solution, however, presents several drawbacks. By virtue of not forming part of the seal, the protective sleeve must be preassembled, thus increasing assembly cost; being a disposable element, the sleeve not only increases the unit cost of the seal, but also creates disposal problems at the seal-shaft assembly stage; the assembly operation itself requires the use of special tools; and, last but not least, the solution itself is not always feasible, particularly when space is limited.

It is an object of the present invention to provide a rotary shaft seal featuring a sealing lip protection element designed to overcome the aforementioned drawbacks, and which in particular, by virtue of forming an integral part of the seal, may be applied cheaply and effectively in all cases.

According to the present invention, there is provided a seal for the seat of a rotary shaft, the seal comprising a metal support; an elastomeric element cured on to the support and having at least one annular sealing lip; and an element for protecting and centering the sealing lip; characterized by the fact that said protection and centering element consists of a dust ring forming an integral part of the seal and interference fittable to the shaft so as to rotate, in use, angularly integral therewith; said ring being housed idly and in axially slack manner inside an annular channel seat formed integral with the support and engaged by the peripherally outer edge of the ring; said channel seat being located axially outwards in relation to the sealing lip in the insertion direction of the seal inside the shaft seat.

In particular, the sealing lip defines a shaft mating and insertion hole larger in diameter than a corresponding shaft mating and insertion hole defined radially inwards by the dust ring.

According to a preferred embodiment, the support is in the form of a cup-shaped body comprising a first flange portion defining the end wall of the cup-shaped body and provided with said elastomeric element radially inwards in the insertion direction inside the shaft seat; and a sleeve portion projecting in the insertion direction inside the shaft seat and perpendicular to the first flange portion; said channel seat for the dust ring being defined by the L-shaped edge of a second flange portion of the support, peripherally outwards in relation to the sleeve portion, and bent 180° on to the sleeve portion so as to define with it a lateral wall of the cup-shaped body for fitment to the shaft seat.

As such, the dust ring may be fitted easily, cheaply and permanently to the support, so as to form an integral, inseparable part of the seal. What is more, it is housed loosely, and hence free to move, inside the channel seat; and, by virtue of presenting a smaller diameter shaft mating hole as compared with the sealing lip/s, it provides for preventing the sealing lip/s from sliding over the shaft when seating the seal (or shaft), and, above all, for centering the entire seal in relation to the shaft. Once the seal is assembled and the protection and centering function of the dust ring completed, the dust ring (unlike currently used disposable protection elements) provides for further protecting the sealing lip/s, this time against external pollutants, by remaining angularly secured by friction to the shaft with which it therefore rotates, thus providing for a spinning action which enhances the efficiency of the seal as a whole and increases its working life by protecting the elastomeric sealing element. Finally, assembly of the seal is simplified, requires no special tools, and poses no disposal problems.

A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a shaft seat featuring a seal in accordance with the present invention;

Figure 2 shows a larger-scale radial section of a portion of the seal according to the present invention, the portion not shown being symmetrical;

Figures 3 and 4 show schematic views to different scales of two possible variations of a detail of the Figure 1 and 2 seal.

Number 1 in Figures 1 and 2 indicates a seal for the seat 2 of a rotary shaft 3 (both shown schematically). Seat 2 may be the seat on an engine block (or any support) 4 for the passage of shaft 3, e.g. the drive shaft of an internal combustion engine; though the following description obviously also applies to elements 3, 4 consisting, for example, of the inner and outer rings of a rolling bearing, or any two mechanical parts rotating in relation to each other.

Whichever the case, seat 2 presents an axial stop shoulder 5 for seal 1, defining the end of seat 2 and hence the only insertion direction of seal 1 inside seat 2, as shown by arrow 6 in Figure 1. Here and hereinafter, anything facing shoulder 5 (or moving in the direction of arrow 6) is to be understood as facing "inwards" of shaft seat 2; and anything facing the opposite way (or moving in the opposite direction to arrow 6) is to be understood as facing "outwards of shaft seat 2.

Seal 1 comprises a metal support 10; and an elastomeric element 11 cured on to support 10 and having one or more annular sealing lips 12 designed, in use, to cooperate in sliding and fluidtight manner with the outer lateral surface 3a of shaft 3. In the non-limiting example shown, element 11 comprises one lip 12 with a V-shaped radial section and fitted radially outwards (i.e. on the opposite side to shaft 3) with a known garter spring 13. More specifically (Figure 2), lip 12 defines, radially towards the axis of symmetry A of seal 1 coincident with the rotation axis of shaft 3, a hole 14 for fitment and insertion of shaft 3.

According to the present invention, seal 1 also comprises a dust ring 16 mounted and designed, as described later on, to act as a protection and centering element for sealing lip 12. Ring 16 defines, radially inwards towards axis A, a hole 18 for fitment and insertion of shaft 3, and which, according to the present invention, is smaller in diameter than the corresponding hole 14 defined by lip 12, and in any case smaller in diameter than shaft 3. By means of hole 18, ring 16 is thus interference fittable to shaft 3 and, in use, remains angularly integral with, and hence rotates together with shaft 3.

Ring 16 is housed idly and in axially slack manner inside an annular channel-shaped seat 20 facing axis A and formed integral with support 10. Seat 20 is located axially outwards in relation to sealing lip 12 in the insertion direction of seal 1 inside shaft seat 2, i.e. is formed on the opposite side of support 10 to shoulder 5, so as to maintain ring 16 closer to the inlet of seat 2 as compared with lip 12. Seat 20 is engaged by the peripherally outer edge 21 of ring 16, so that ring 16 is nonwithdrawable and forms one piece with and an integral part of seal 1.

Support 10 is in the form of a cup-shaped body 31 with its concavity facing away from ring 16, and comprises a first flange portion 32 defining the end wall of cup-shaped body 31; and a sleeve portion 33 projecting in the insertion direction inside shaft seat 2 (i.e. away from ring 16), and perpendicular to flange portion 32 which presents elastomeric element 11 radially inwards in the insertion direction inside shaft seat 2, i.e. on the opposite face to ring 16.

Support 10 also comprises a second flange portion 34 located peripherally outwards of sleeve portion 33, on the opposite side to portion 32, bent 180° about a bend 37 on to and parallel to portion 33 (and axis A), and defining, with portion 33, a lateral wall 38 of cup-shaped body 31, for enabling fitment of body 31 and seal 1 as a whole to shaft seat 2.

According to the present invention, channel seat 20 of ring 16 is defined by the L-shaped edge 35 of flange portion 34. Support 10 in fact is made of relatively rigid but permanently deformable material, and is formed with edge 35 parallel to portions 33, 34, as shown by the dotted line in Figure 2. Subsequently, after curing element 11 and fitting ring 16 (produced separately) on to portion 32, on the opposite side to element 11, edge 35 is bent 90° in known manner, e.g. rolled, so as to extend parallel to portion 32 and so lock ring 16.

According to the preferred embodiment shown, elastomeric element 11 extends on the same side (i.e. the opposite side to ring 16) of all three portions 32, 33, 34 of support 10, so that lateral wall 38 of cup-shaped body 31 defined by support 10 is covered by elastomeric element 11 on both the inside and outside of body 31. More specifically, on portion 34 and substantially flush with edge 35, an annular elastomeric bearing 39 with an undulated outer surface is formed, which mates frictionally and in fluidtight manner with the inside of seat 2, and, at bend 37, forms a shoulder 40 designed to cooperate, in use, with shoulder 5.

As shown in Figure 2, dust ring 16 comprises a first radially-inner annular portion 41 made of elastomeric material so as to mate frictionally with shaft 3; and a second radially-outer annular portion 42 having edge 21 and made of relatively rigid material, preferably synthetic plastic such as polyamide, capable of rotating with very little friction inside seat 20.

With reference also to Figures 3 and 4, face 44 of ring 16, facing the opposite way to the insertion direction of seal 1 inside shaft seat 2, i.e. on the opposite side to flange portion 32, presents coils 45 designed, in use, to spin off any pollutant substances. In the Figure 4 variation, coils 45 are defined, in the example shown, by a number of turbine type blades 46 arranged in a ring and

formed in one piece with portion 42. In the larger-scale variation shown in Figure 3, on the other hand, ring 16 comprises a rigid insert 50 to which is cured an elastomeric element 51 projecting radially from insert 50 towards axis A so as to form a portion 41 mating with shaft 3, and extending over face 54 of insert 50, on the opposite side to support 10, so as to cover and form on face 54 a number of tabs 55.

In all cases, once ring 16 is fitted to support 10 as described above, seal 1 is fitted to shaft 3 by inserting the shaft through holes 14, 18. Since hole 18 is smaller than hole 14, it is ring 16 which undergoes the wear produced by sliding over surface 3a during assembly, thus preserving lip 12; and, being assembled coaxial with support 10 and lip 12, but with a certain freedom of movement, ring 16 also provides for centering lip 12 and seal 1 as a whole on shaft 3. After assembly, the interference fit with shaft 3 results in ring 16, in use, being rotated in relation to seat 20 and the rest of seal 1, so that any external pollutants come into contact with face 44 (or 54) of ring 16 and are spun outwards, which spinning action, for a given rotation speed, is enhanced by coils 45. Finally, ring 16 provides for retaining grease close to lip 12, thus improving sealing performance, reducing friction, and extending the working life of seal 1.

## Claims

1. A seal (1) for the seat (2) of a rotary shaft (3), the seal comprising a metal support (10); an elastomeric element (11) cured on to the support (10) and having at least one annular sealing lip (12); and an element (16) for protecting and centering the sealing lip (12); characterized by the fact that said protection and centering element consists of a dust ring (16) forming an integral part of the seal and interference fittable to the shaft (3) so as to rotate, in use, angularly integral therewith; said ring (16) being housed idly and in axially slack manner inside an annular channel seat (20) formed integral with the support (10) and engaged by the peripherally outer edge (21) of the ring (16); said channel seat (20) being located axially outwards in relation to the sealing lip (12) in the insertion direction of the seal (1) inside the shaft seat (2).

2. A seal (1) as claimed in Claim 1, characterized by the fact that said sealing lip (12) defines a shaft mating and insertion hole (14) larger in diameter than a corresponding shaft mating and insertion hole (18) defined radially inwards by said dust ring (16).

3. A seal (1) as claimed in Claim 1 or 2, characterized by the fact that said support (10) is in the form of a cup-shaped body (31), and comprises a first flange portion (32) defining the end wall of the cup-shaped body and provided with said elastomeric element (11) radially inwards in the insertion direction inside the shaft seat (2); and a sleeve portion (33) projecting in the insertion direction inside the shaft seat (2), and perpendicular to said first flange portion (32); said channel seat (20) for the dust ring (16) being defined by the L-shaped edge (35) of a second flange portion (34) of the support (10), peripherally outwards in relation to the sleeve portion (33), and bent 180° on to the sleeve portion (33) so as to define with it a lateral wall (38) of the cup-shaped body (31), for fitment to the shaft seat (2).

4. A seal (1) as claimed in Claim 3, characterized by the fact that said elastomeric element (11) extends over the same side of all three said portions (32, 33, 34) of the support (10), so that the lateral wall (38) of the cup-shaped body (31) defined by the support (10) is covered with the elastomeric element (11) on both the inside and outside of the cup-shaped body (31).

5. A seal (1) as claimed in one of the foregoing Claims, characterized by the fact that said dust ring (16) comprises a first radially-inner annular portion (41) made of elastomeric material for mating with the shaft (3); and a second radially-outer portion (42; 50) made of relatively rigid material, preferably synthetic plastic.

6. A seal (1) as claimed in Claim 5, characterized by the fact that the face (44; 54) of the dust ring (16) facing the opposite way to the insertion direction of the seal inside the shaft seat (2) presents coils (45) for spinning off, in use, any pollutant substances.

FIG.3

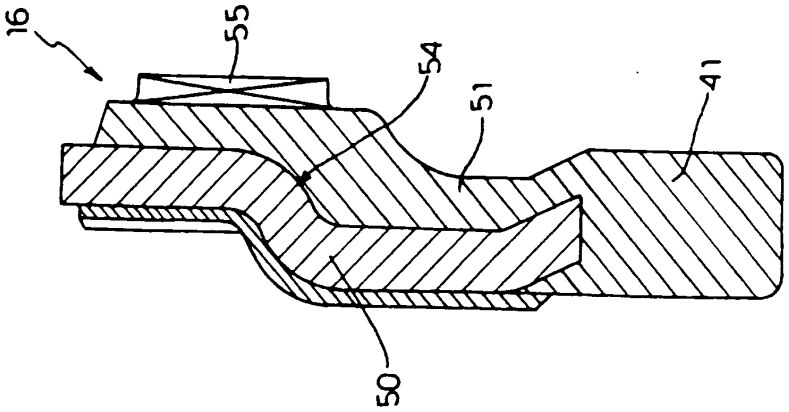



FIG.4

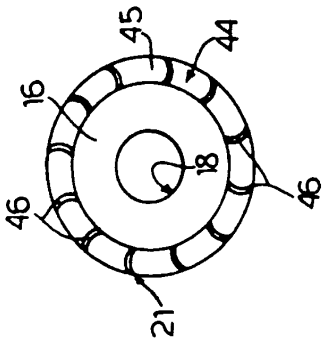



FIG.1

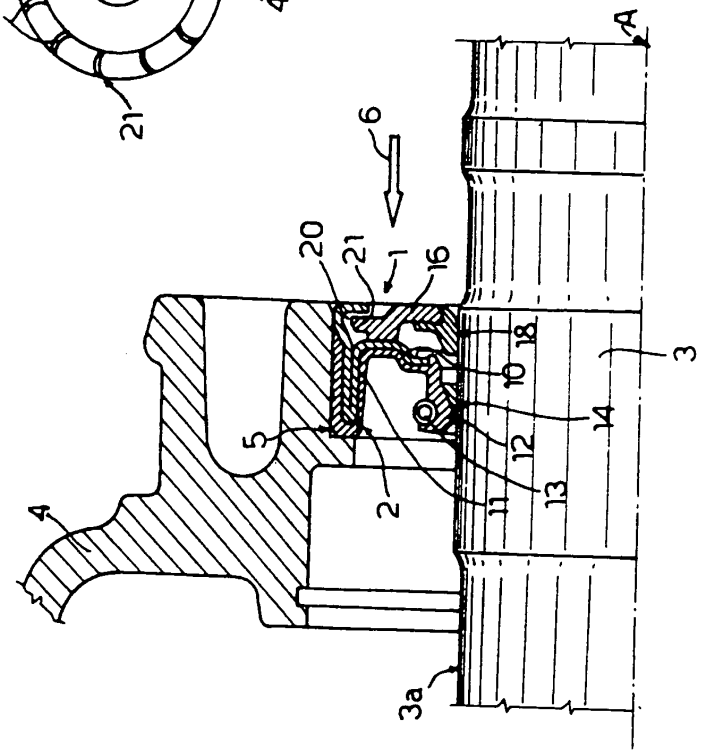
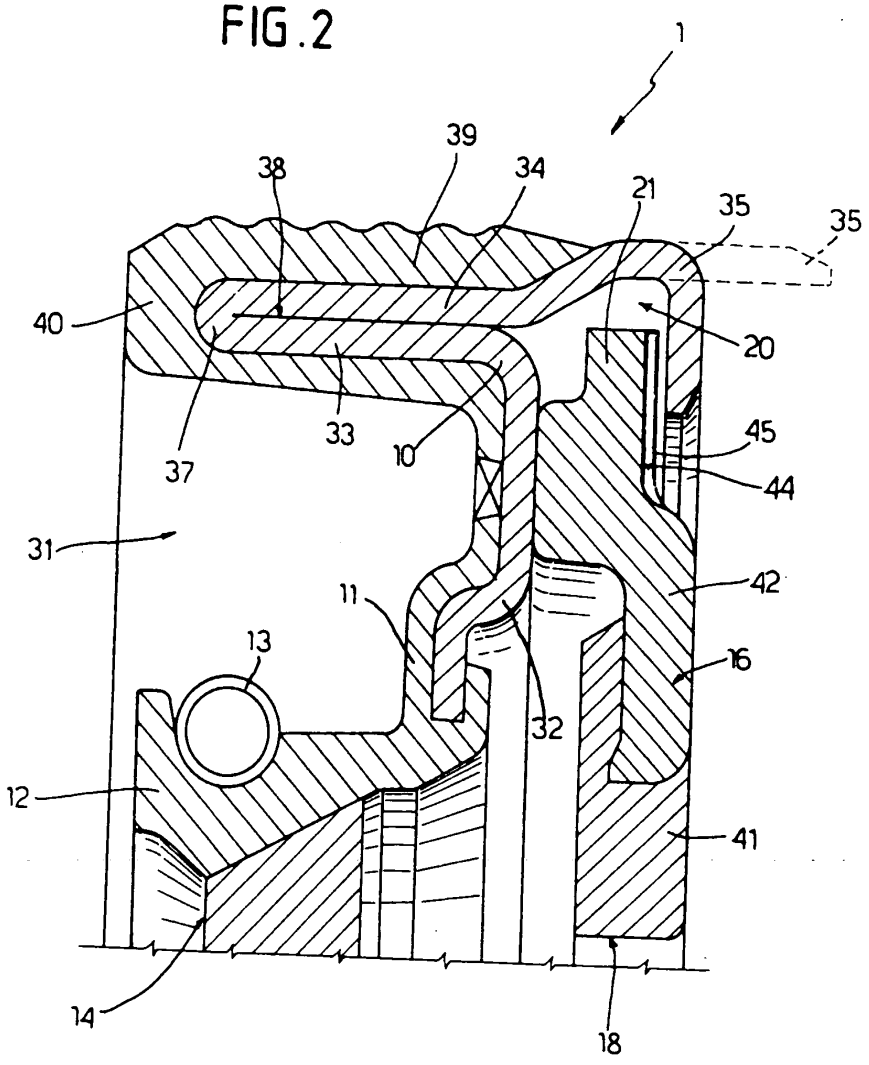


FIG.2



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# EUROPEAN SEARCH REPORT

Application Number
EP 94 10 1485

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.5) |
|---|---|---|---|
| X<br>A | EP-A-0 289 148 (EATON CORP.)<br>* column 4, line 13 - column 5, line 47; figures *<br>--- | 1,5,6<br>3 | F16J15/32 |
| A | US-A-4 861 045 (RILEY)<br>* abstract; figures *<br>--- | 1 | |
| A | US-A-4 376 541 (WALTER ET AL.)<br>* abstract; figure 2 *<br>----- | 1 | |

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

F16J

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 8 April 1994 | Narminio, A |

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